CDC
CENTERS FOR DISEASE CONTROL AND PREVENTION

HIP
Hospital Infections Program

NNIS News 2000

National Nosocomial Infections Surveillance System

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Beyond Y2K: Summary of the NNIS Session at the 4th Decennial Conference

On March 8, 2000, nearly 500 people gathered in Atlanta in a session of the 4th Decennial International Conference on Nosocomial and Healthcare-associated Infections to hear discussions of the NNIS System and its directions for the next decade. Grace Emori moderated the session that began with review of the state of the NNIS system by Dr. Robert Gaynes. He was followed by Dr. Scott Fridkin, Teresa Horan, Jonathan Edwards, and Dr. Juan Alonso-Echanove who reviewed progress with antimicrobial use and resistance and risk-adjustment advances in surgical patient and ICU surveillance.

The State of the NNIS System, 2000

Ten years ago at the 3rd Decennial International Conference on Nosocomial Infections, we presented and later published in the proceedings of that conference, a paper entitled "The NNIS System: Plans for the 1990s and Beyond" (Am J Med 1991;91(3B):116S-120S). Three major plans for the decade were described: 1) To disseminate NNIS data (top priority); 2) To evaluate the quality of the NNIS data; and 3) To develop credible, reliable, quality indicators that could be used by NNIS hospitals for comparative purposes. We have had a high degree of success in achieving each of these goals! To disseminate NNIS data, we sent the first Semiannual Report (SAR) to NNIS hospitals in 1991. Every year since, we have produced and distributed two SARs. The data from each of these is incorporated into IDEAS for interhospital rate comparisons. In addition, the SAR has been pub-

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Coordinator's Corner

How rewarding it was to see the collaborative efforts between CDC and NNIS system participants featured prominently at the 4th Decennial International Conference on Nosocomial and Healthcare-associated Infections! Our feature story briefly summarizes a decade of progress and highlights areas of future research. Several manuscripts are being prepared and will be shared with you as soon as they are available.

Don't forget to check the NNIS member web page periodically for information like answers to frequently asked questions (FAQs) about IDEAS. You'll find the Semiannual Report–current issue (June 2000) as well as back issues–posted there as well. Please let us know what else you'd like to see included on the page.

We enjoyed meeting with you at the 4th Decennial Conference and at APIC 2000. Thank you for your continued efforts in keeping the NNIS system as the leader in hospital-based infection prevention. Have a great summer!

Teresa Horan, **NNIS Coordinator**

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lished annually in American Journal of Infection Control since 1996, and been available on the Internet at www.cdc.gov/ncidod/hip/surveill/nnis.htm.

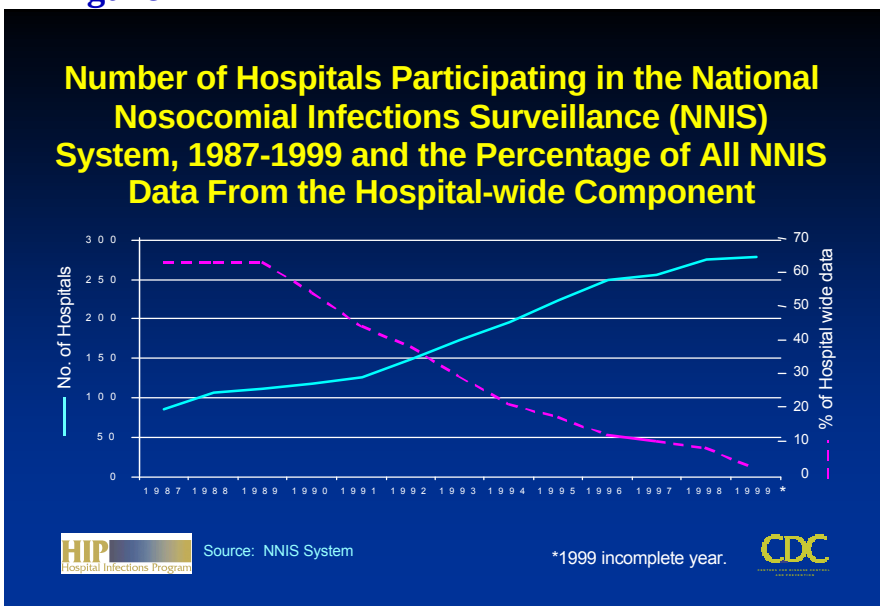
To evaluate the quality of NNIS data, we undertook a pilot study of infection detection in ICU patients (Infect Control Hosp Epidemiol 1998;19:308-16). This study showed that, in general, case-finding by NNIS ICPs was quite accurate. In terms of quality indicators, we recently published an article entitled "Monitoring Hospital-acquired Infections to Promote Patient Safety–United States, 1990-99" (MMWR 2000;49:149-52). This article showed dramatic decreases in device-associated infection rates from NNIS hospitals in the 1990s and demonstrated that systems like the NNIS system can be successful in preventing nosocomial infections.

Other key developments in the 1990s that contributed to the success of the NNIS system were technological advances with the telecommunications system, revisions of the IDEAS software, and Internet communications with the NNIS hospitals. Data exchange with other organizations, another goal in 1990, was achieved with the development of the NNISAPIC performance measurement system, a cooperative venture between APIC's Center for Clinical Epidemiology and CDC.

Expansion of the NNIS database was yet another goal in 1990. The number of participating NNIS hospitals has increased from 109 in 1990 to 315 in January 2000. Of the 315 NNIS hospitals in 2000, 85% are general medical/surgical, acute care hospitals, 8% are Veterans Administration hospitals, 6% are children's hospitals, and 1% are women's hospitals. The median size of these hospitals is 360 beds. The teaching affiliation of the hospitals varies: 58% are major teaching hospitals, 10% are graduate teaching, 15% are limited teaching, and 16% are not affiliated with a medical school. Despite the increase in the numbers of participating hospitals, the data CDC receives from the various NNIS surveillance components has varied dramatically. The percentage of all NNIS data reported from the hospital-wide component has decreased during the decade to only 7% of all NNIS data in 1999 (Figure 1). Data from the Adult and Pediatric ICU component increased 4-fold during the same period. Similarly, data from the High Risk Nursery component increased 8-fold during the 1990s. Finally, the number of hospitals participating in the Surgical Patient component showed a 5-fold rise in the decade (Figure 2). We are most grateful to all of you who have contributed to this striking rise in NNIS data.

Several developments are underway to continue to improve on the success of the NNIS system. First, the development of an Internet- or web-based software to replace IDEAS for the NNIS system is well underway. Second, improvements to the surveillance component protocols, specifically designed to improve risk adjustment for comparative rates, as well as new components are planned. The design and impact of these changes were outlined at the NNIS session for each component and are summarized below.

Figure 1

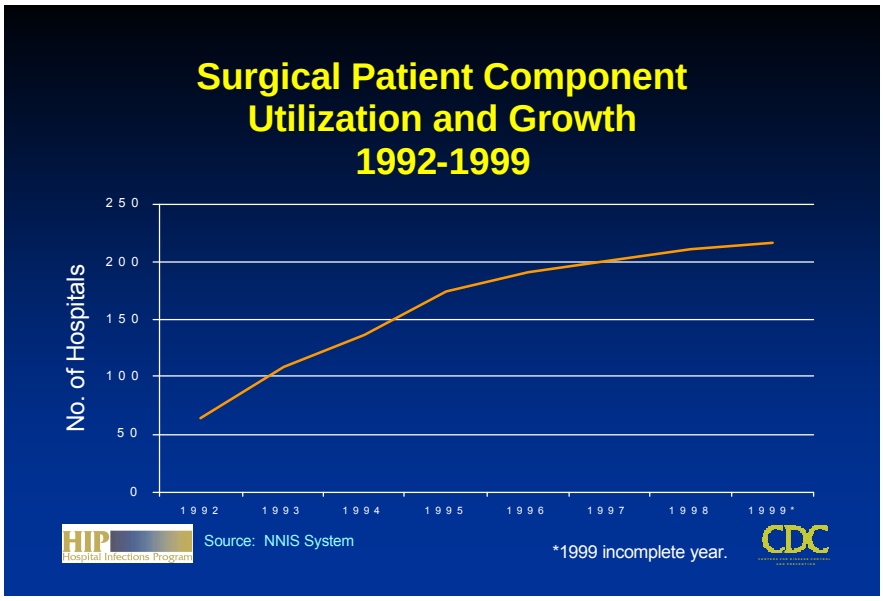


Advances in ICU Surveillance

In 1986, we introduced a surveillance component for the rou-

tine surveillance of ICU-associated infections. Infection rates in an ICU depend on the frequency of exposure to major extrinsic risk factors and on the type of patients (or case mix) admitted to the unit. In order to compare in a more meaningful way the ICU infection experience, we needed risk-adjustment techniques that would control for the inter-unit variation in the distribution of major risk factors for infection (invasive devices) and for case mix (type of ICU). Therefore, both the use of device-associated rates and reporting such rates stratified by type of ICU were established and included in the first SAR in 1991. The NNIS risk-adjustment methodology has proven useful for assessing trends in ICU infection rates both in individual hospitals as well as at a national level. Indeed, it has transformed the NNIS system from a surveillance system capable only of describing the scope and magnitude of nosocomial infections into a performance measurement system capable of assessing the impact of infection control interventions. However, the system has several important limitations and opportunities for improvement. First, our current risk-adjustment techniques are limited because device-associated rates only control for one major risk factor, risk-adjusted rates are only provided for three major infection sites, and the type of ICU is only a surrogate for case mix. Second, currently we cannot measure outcomes such as excess length of stay, cost, and mortality that are critical elements of a performance measurement system. Improving our current risk-adjustment techniques and measuring the cost and efficacy of our prevention programs have, therefore, become the challenge for the next decade.

Figure 2



To improve risk adjustment, we launched the Detailed ICU Surveillance Component (DISC) Study in November 1997. This was a two-year prospective, observational cohort study in 8 different ICUs at NNIS hospitals. On *every* patient admitted to these units, we collected *daily* information on over *60* different potential *intrinsic and extrinsic* risk factors. Although the analysis of the study is preliminary, we already can draw several conclusions. First, the analysis of potential intrinsic or extrinsic risk factors for device-associated infections shows very complex relationships. Second, of over 60 potential risk factors, only a handful are strongly associated with an increased risk of infection and occur frequently enough to be useful for surveillance purposes. Third, as expected, most of these major risk factors are specific for a particular infection site. For example, risk factors for pneumonia include use and duration of mechanical ventilation or use of nasogastric tube. However, risk factors for bloodstream infection include use of central line(s), use of total parenteral nutrition (TPN), or insertion of the central line at the bedside rather than the operating room. Thus, it is very unlikely that we will be able to identify a single summary measure of severity of illness (such as APACHE) that will be useful for every type of infection. Fourth, and most important, to further improve risk-adjustment, we will need infection site specific information, which means collecting some data for each patient in the ICUs monitored. Keeping the data collection burden to a minimum is the challenge as we develop this into a new surveillance component protocol.

How will we use the information derived from such a new component? In the future, instead of providing you with benchmark device-associated infection rates for comparison,

we'll use the prediction equations from the multivariate models to determine the number of "expected" infections. This number divided by the observed number of infections is the standardized infection ratio, or SIR. The SIR, as you know from the current Surgical Patient component, is a risk-adjusted summary measure. Of course, the web-based software will do all the calculations and statistical comparisons for you.

In summary, we are moving towards a detailed, patient-level ICU component, as we did with the surgical patient component almost 15 years ago. Such a patient-level data collection is a critical step that may initially increase the workload but will benefit dramatically both patients and the infection control community.

Advances in SSI Risk Adjustment

Ten years ago at the 3rd Decennial International Conference on Nosocomial Infections, we presented a paper on the Basic NNIS SSI Risk Index. The index was comprised of three equally important and equally weighted risk factors: dirty or infected wound class, ASA score of 3, 4, or 5, and duration of operation exceeding a procedure-specific cut point. These and several other potential risk factors–like age, gender, emergency, and trauma–were collected on every patient who underwent an operation that was chosen for monitoring by the ICP. This list was expanded in 1992 to include use of laparoscope and whether multiple procedures were performed through the same operative incision. As initially shown in 1990, the Basic Index worked well to stratify the risk of SSI following most, but not all, operations. In the early 1990s, we targeted four operations for collecting specific risk factor data to determine if the index could be improved. Results for three of the operations–CSEC, FUSN, and CRAN–were reported at the 4th Decennial conference.

Another step in improving risk adjustment has been to analyze some of the other potential risk factors collected. We began by looking at laparoscopes since these devices have been increasingly used to perform operations during the past decade. We hypothesized that such minimally invasive surgery would result in significantly fewer SSI than traditionally incised operations. We found that this was true for four operations: CHOL, COLO, GAST, and HER. Therefore, as a way to improve risk adjustment for these operations, we incorporated use of laparoscope into the risk index (called the Modified NNIS SSI Risk Index) and began publishing the new index in the SAR in 1998.

As a further improvement to risk adjustment for CHOL, we analyzed all of the potential risk factors collected. We found that while all of the Basic Index factors were still important independent predictors of risk, and that use of laparoscope was still protective, there were several additional factors that emerged from the multivariate model. The same type of modeling analysis was performed on the data collected from the CSEC, FUSN, and CRAN studies. The results showed that while one or more of the Basic Index factors was significantly associated with increased risk of SSI, there were other important factors. And, for some operations, for example, CSEC, the risks were different for incisional and organ/space SSI. Also, the weight of each of the risk factors was not equal for each operation. Therefore, we concluded that we cannot simply modify the Basic Index to achieve the best risk adjustment. Instead, we will be fitting multivariate models to the data for each operation and using the resulting prediction equations to determine the number of expected SSI. As with the new ICU component, the expected number of SSI will then be used in conjunction with the observed number of SSI to calculate the SIR.

We believe that the use of multivariate prediction models and the SIR is a major step in risk adjustment of SSI data that will be extremely valuable in the new decade. Such data will help identify areas for targeting quality improvement efforts leading to improved patient safety.

Advances in Monitoring Antimicrobial Resistance and Use in Hospitals

The development of accurate and valid methods to reduce the emergence and spread of antimicrobial-resistant pathogens is a first critical step in combating antimicrobial resistance in the healthcare settings. In the hospital setting, the predominant factors related to antimicrobial resistance include cross-transmission of existing or imported resistant organisms, and emergence of resis-

tance in susceptible hosts due to selective antimicrobial pressures. Understanding which factors are most causally related to a hospital's specific resistance problem may be difficult or impossible to determine given the scarce resources available to infection control programs. Project Intensive Care Antimicrobial Resistance Epidemiology (ICARE) was undertaken in about 70 NNIS hospitals from 1994-1999, and was an ecological study of antimicrobial use and resistance. Data from Project ICARE have been used to quantify the relationship between antimicrobial use and resistance for several organisms, study the epidemiology of vancomycin use, and develop rational and valid comparative data on antimicrobial use and resistance for intra-hospital or inter-hospital comparison. In an effort to provide infection control staff with a tool to target their limited resources in combating antimicrobial resistance, we have adapted methods from Project ICARE into the new Antimicrobial Use and Resistance (AUR) Component of the NNIS system.

The AUR component provides users with inter-hospital comparisons of aggregated data on selected antimicrobial use and resistance parameters. These comparisons have been integrated into the IDEAS software to provide timely comparisons for participants. Preliminary data suggest that ICARE hospitals have used such comparative data to institute practice changes around vancomycin use, lowering the amount of vancomycin used in these hospitals. Further demonstration projects of impact on antimicrobial use and resistance are upcoming and results will be sent to NNIS hospitals as they become available.

Summary

Just as the only constant in the world is change, the NNIS system will need to change to maintain its position as the premier performance measurement system for hospital-acquired infections in the world. We thank you for all your efforts and look forward to another decade of continued progress together.

Participants at the 4th Decennial International Conference on Nosocomial and Healthcare-Associated Diseases sign up for HIP's New Rapid Notification System.

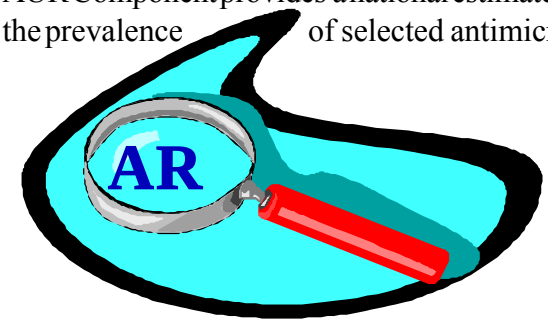
NNIS Proficiency Testing: A Job Well Done!

The first NNIS proficiency testing, performed by 193 laboratories representing 204 NNIS hospitals, is now completed. The organisms tested were: a methicillin-resistant *Staphylococcus aureus*, a vancomycin-intermediate *S. epidermidis*, an imipenem/meropenem-resistant *Serratia marcescens*, a low-level vancomycin-resistant *Enterococcus faecalis*, and an extended spectrum $-lactamase (ESBL) producing *Klebsiella pneumoniae*. These organisms represented both established (i.e., MRSA) and emerging types of antimicrobial resistance. Since many of the laboratories had never processed organisms from clinical cultures with these novel resistance patterns, we expected that proper detection would be challenging. We are very pleased with the overall results. With regards to the methods of antimicrobial susceptibility testing,

Continued on page 7

New NNIS Component Monitors Antimicrobial Use and Resistance

In January 2000, NNIS introduced a new surveillance protocol called the Antimicrobial Use and Resistance (AUR) Component. Participating hospitals provide data on antimicrobial use and resistance on a monthly basis by hospital area: intensive care unit (ICU), all non-ICU inpatient areas, and all outpatient areas combined. The AUR Component provides a national estimate of the prevalence of selected antimicrobial-resistant organisms isolated from hospitalized patients, details the amounts of antimicrobial agents used in these hospitals, and allows for interhospital comparison of the use of selected antimicrobial agents and the prevalence of antimicrobial resistance. NNIS hospitals can use these data to help monitor their use and resistance, as well as for quality improvement efforts.

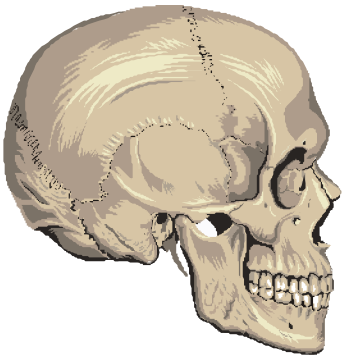


The AUR Component uses methodology developed from a recently completed NNIS study–Project ICARE (Intensive Care Antimicrobial Resistance Epidemiology)–a collaboration between CDC and Emory University's Rollins School of Public Health. Project ICARE helped determine the availability of antimicrobial use and resistance data, established a standard methodology, and provided a useful tool for hospitals to benchmark their antimicrobial use and resistance data.

We encourage all NNIS participants to use the AUR Component. If you have any questions or need additional information, please call Rachel Lawton at 800-893-0485, or e-mail her at rlawton@cdc.gov.

More Data Needed for Craniotomy SSI Risk Factor Study

At the 4th Decennial International Conference on Nosocomial and Healthcare-associated Infections in March 2000, Grace Emori presented a poster on a preliminary analysis of risk factors for SSI following craniotomy operations. The findings were based on 53 SSI, of which 29 were deep infections, identified in 2,895 craniotomy operations performed between 1994 and 1999 in 18 NNIS hospitals. The data were reported through the supplemental risk factor study in the NNIS surgical patient component, which is being conducted for the purpose of improving the Basic NNIS SSI Risk Index.



In this analysis, we found only one risk factor—multiple operations through the same incision—predicted increased SSI risk following craniotomy. When only deep SSI were examined, patients who had multiple operations through the same incision and those on antibiotic therapy for infection at another site appeared to be at increased risk. Supplemental risk factors that were included in this study that do not appear to increase the risk of SSI were intracranial pressure monitoring device, radiation or chemotherapy, steroid therapy, antibiotic prophylaxis, and primary or repeat craniotomy.

SSI following craniotomy can be serious and developing strategies for preventing them requires a better understanding of the contributing risk factors. The amount of supplemental craniotomy data reported thus far is insufficient to make definitive statements on the risk factors. During the time period of this analysis, over 10,000 craniotomy operations were reported to the NNIS system. We urge more NNIS hospitals to report supplemental craniotomy risk factor data. The data

collection form and instructions can be found on the NNIS member website www.cdc.gov/ncidod/hip/NNIS/members/members.htm.

Further, additional supplemental data are needed on ventricular shunt (VSHN) operations. Since 1994, supplemental data on 163 SSI have been reported from 3029 VSHN operations. Similar to craniotomy, the number of VSHN operations reported is insufficient for meaningful analysis for risk factors. The data collection form and instructions for VSHN can also be found on the NNIS member website.

NNIS Profeciency- Cont. from page 5

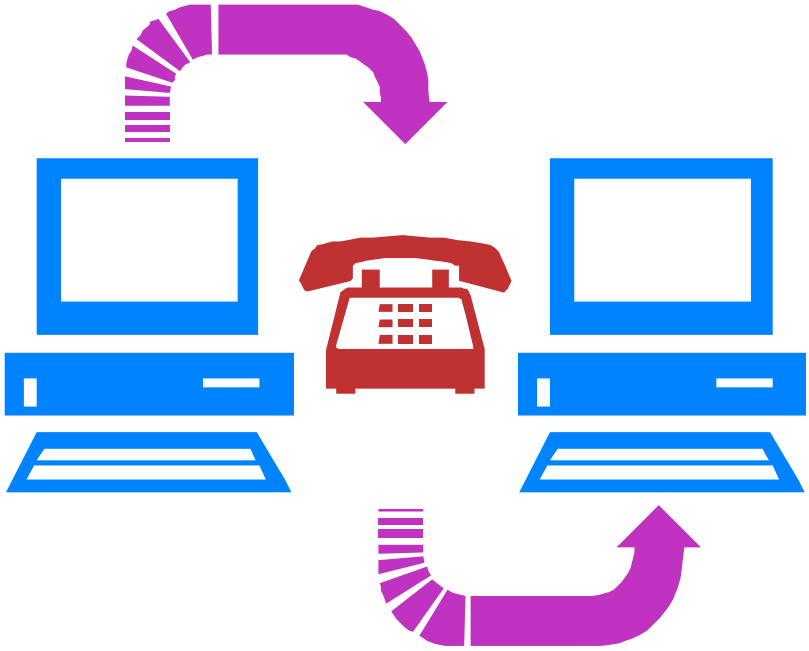
there are two points that deserve attention:

- Disk diffusion should not be used when testing vancomycin against staphylococci. In order to recognize strains with vancomycin minimum inhibitory concentrations (MICs) of 4-8 : g/ml (i.e., vancomycin-intermediate staphylococci) MIC testing must be performed. For laboratories that wish to have confirmatory and expedited susceptibility testing for these strains performed at CDC, please email SEARCH@cdc.gov.
- ESBL recognition proved to be a problem for some laboratories. Yearly, the National Committee for Clinical Laboratory Standards (NCCLS) describes the methods for ESBL detection and confirmation. Over the past couple of years the NCCLS has modified its testing recommendations. Therefore, it may be good to reinforce with the microbiology laboratories the need to review the NCCLS document annually.

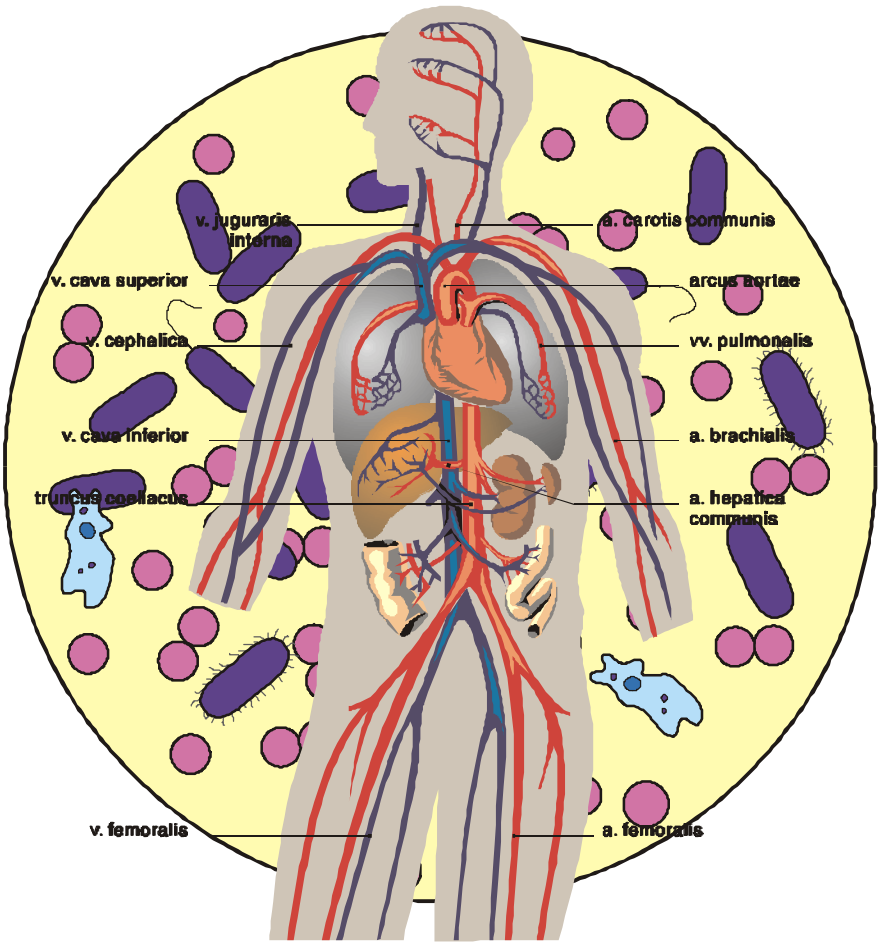
The success of the laboratories as a group has made us confident in the accuracy of antimicrobial susceptibility data reported to the NNIS system. We have sent individual reports to each laboratory. We encourage you to meet with your laboratory to discuss your hospital's results. Many thanks to all involved in making this testing possible.

Closing the Loop on a Successful Data Transmission Session

When transmitting your data to CDC by modem, you will know that the session was successful only when the following message appears on the screen: *NNIS data was successfully transmitted.* Prior to this, you should see this message: *Successful Session*, which means that your modem successfully connected to the CDC modem. However, since connection does not mean transmission of data has occurred, you must wait until you are prompted that the transmission was successful in order to close the loop. For more detailed information, please refer to the FAQ entitled "Acknowledging Receipt of Your Data" posted on the NNIS member web page at www.cdc.gov/ncidod/hip/NNIS/members/members.htm.



Surveillance for Bloodstream and Vascular Access Infections in Outpatient Hemodialysis Centers



Bacterial infections pose a significant threat to hemodialysis patients that can result in frequent hospitalizations and use of antimicrobial agents, which in turn can promote the emergence of antimicrobial resistance in these patients. Quantifing the problem has been difficult partly due to a lack of standardized methods for detecting infections in dialysis patients. Therefore, in August 1999, the CDC's Hospital Infections Program (HIP) introduced a national surveillance system for bloodstream and vascular access infections in outpatient hemodialysis centers. The data collection methods are simple and several benchmark infection rates and measures are routinely fed back to participating centers. The goal of the system is to provide data that can be used to improve care for these vulnerable patients.

At present, HIP is recruiting both adult and pediatric outpatient hemodialysis centers for participation. Hospital-based dialysis units are also invited to participate if they treat outpatients in their units.

Currently surveillance data are recorded on paper forms and mailed to HIP monthly, and data analysis reports are sent to participating facilities quarterly. However, we are in the process of updating the protocol so that facilities can enter and transmit data through the Internet and generate their own data analysis reports whenever they choose.

The current protocol describing the system can be found at our web site www.cdc.gov/ncidod/hip/Dialysis/dialysis.htm

or by contacting:

Elaine Miller, RN, MPH
Hospital Infections Program
Centers for Disease Control and Prevention
MS E-69
1600 Clifton Road
Atlanta, GA 30333
Phone: (404) 639-6422
Fax: (404) 639-6459
E-mail: erm4@cdc.gov

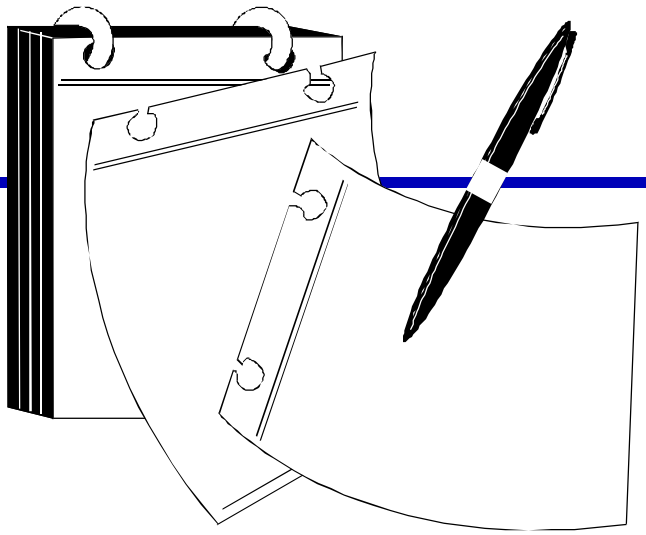
Calendar

NNIS and IDEAS Training Courses:

July 23-26, 2000	CDC	Atlanta, GA
September 24-27, 2000	CDC	Atlanta, GA

NNIS Conference:

Fall 2001 Atlanta, GA



HIP NNIS Personnel

Chief
Robert Gaynes, MD
rpg1@cdc.gov

Coordinator
Teresa Horan, MPH, CIC
tch1@cdc.gov

Epidemiologists
Grace Emori, RN, MS
tge1@cdc.gov

Scott Fridkin, MD
skf0@cdc.gov

Juan Alonso-Echanove, MD
jee4@cdc.gov

EIS Officer
Chesley Richards, MD, MPH
cir6@cdc.gov

AUR Coordinator
Rachel Lawton, MPH
rjl2@cdc.gov

Guest Researcher
Jeffrey Hageman, MHS
uzh7@cdc.gov

Statistician
Jonathan Edwards, MS
jde3@cdc.gov

Computer Technical Support
Gloria Peavy
gep1@cdc.gov

Computer Specialists
Tonya Henderson, BS
tsh1@cdc.gov

James Tolson, BS
jst2@cdc.gov

Jeff Wages
jwages@cdc.gov

Programmer
Jan Abshire, AS, BS, MPH
jpa2@cdc.gov